

EFFECTS OF POSITIVE ACCELERATION ON ATRIAL NATRIURETIC PEPTIDE (ANP), PLASMA RENIN ACTIVITY (PRA) IN HUMAN. J.K. PARK*, Y.M. PARK, SEUL, B.O. PARK*, K.W. CHO. Aeromedical Training Center, Cheongwon, Chungbuk, and Chonbuk National University, Chonju, Korea.

INTRODUCTION. Especially the cardiovascular systems are affected by positive radial acceleration. On accelerated gravity, increase in the levels of stress hormone occurred and secretion of renin from the kidney depends on the blood flow through the glomerulus. ANP released from the atrium and has natriuretic and diuretic effects. The secretion of ANP usually depends on changes of intracardiac volume. The study was done to investigate the changes of secretion of ANP and PRA under the positive acceleration in human. **METHODS.** The subjects included 14 students of Korean Air Force Academy and 7 pilots. The centrifuge profile was a +6Gz for 30 secs. Blood sampling were performed before and after exposure to accelerated gravity. Measurements of ANP and PRA levels were analyzed by radioimmunoassay. **RESULTS.** Mean levels of PRA increased from 2.23ngAl/ml/h to 4.80 (p<0.01) in students and 2.92 to 4.65 (p<0.01) in pilots after exposure. ANP decreased from 38.2pg/ml to 18.6 (p<0.01) in students and 91.0 to 24.2 (p<0.01) in pilots after exposure. **CONCLUSIONS.** Positive acceleration causes an abrupt decrease in the circulating blood volume to the vital organs. Diminution of circulating blood volume to the heart and kidney occurred on positive acceleration in human. These results suggests that renin released from the kidney protect the hypovolemic conditions and decreased ANP release from the atrium diminishes natriuresis and diuresis.

GENDER-BASED CARDIOVASCULAR RESPONSES TO THE VALSALVA MANEUVER. D.D. White* and R.W. Gotshall*. Colorado State University, Exercise & Sport Science and Physiology, Ft. Collins, CO 80523.

INTRODUCTION. Previous studies in this laboratory have shown a gender difference in the cardiovascular (CV) response to standing. Men routinely have demonstrated elevated blood pressure (BP) responses to the stand test, whereas, women maintained BP relative to values when supine. To examine possible gender differences in autonomic and baroreflex function, the CV responses to the Valsalva maneuver (VM) were evaluated in men and women. **METHODS.** This study continuously measured heart rate (HR), cardiac output (CO), stroke volume (SV), blood pressure (BP), and peripheral resistance (PR) noninvasively throughout the VM. 10 men and 10 women performed the VM (maintained 40 mmHg intrathoracic pressure for 15 sec of straining) while standing. HR, CO, and SV (impedance cardiography), BP (Finapres™ BP monitor), and PR were continuously measured throughout the maneuver. The responses were expressed as changes from prestraining values. **RESULTS.** By the end of the straining maneuver, men had elevated BP, while women had BP values similar to prestraining (PVM). HR response was not different for the sexes. At the end of the strain, CO reductions were greater in women than men, while increases in PR were similar for men and women. **CONCLUSIONS.** These results show, by the end of the VM, women maintain BP close to PVM values and men have a hypertensive response. Similar to orthostatic stress, women maintained BP and men overcompensated elevating BP above normal during the CV challenge. Because BP control in women was different from men, women and men should be studied as separate groups when evaluating CV function. This is an important consideration when investigating the effects of microgravity or +Gz on the CV system in women and men.

SPECTRAL COMPONENTS OF HUMAN CARDIOVASCULAR RESPONSES TO STEP CHANGES IN LOWER BODY NEGATIVE PRESSURE (LBNP) BEFORE AND AFTER 22 HR OF 6° HEAD DOWN BED REST.

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Changes in autonomic outflow to peripheral organs during the development of bedrest induced, orthostatic intolerance have not been determined. Recent studies have indicated that spectral analysis provides an indirect assessment of these changes. Eight male subjects were studied before and after 22 hours of 6° head down bedrest plus Lasix (40 mg, P.O.). Cardiovascular spectra (using an autoregressive technique) were determined from 2.5 minute segments during control, LBNP (-10, -20, -30, -40, -50 mmHg) and recovery. Bedrest increased HR spectral power in the low frequency (.001 to .041 Hz) range, increased RF power in the low and mid (.04 to .18 Hz) frequency range and increased AP power in the high frequency (.18 to .50 Hz) range. Increasing levels of LBNP decreased HR power and increased RF power in the high frequency range and decreased AP power in the low frequency range. Since spectral power of HR in the high frequency range has been shown to indicate parasympathetically mediated regulation and power in the low and mid frequency ranges indicate a sympathetic / parasympathetic mixture, then both bedrest and LBNP appeared to shift sympathetic / parasympathetic balance toward sympathetic regulation of HR. The interpretation of the spectral content of AP and RF with respect to their autonomic origins remains unclear. Supported by NASA NAG9 298.

CHRONIC CATECHOLAMINE ADMINISTRATION INDUCES DOSE DEPENDENT CHANGES IN SKELETAL MUSCLE MYOSIN ISOZYMES AND FIBER TYPES DURING HINDLIMB SUSPENSION. B. Gitten*, A.J. Merola, W.M. Sherman, G. Wimer, R. Tuttle. Wright State University School of Medicine, Dayton, OH, Ohio State University, Columbus, OH and Genesia Pharmaceuticals, San Diego, CA.

INTRODUCTION. Several dosages of GP-2-128 (GP-2), a new and very potent synthetic catecholamine, were tested to determine the minimum effective dose capable of significantly altering skeletal muscle myosin isozymes and fiber types. **METHODS.** Adult male Sprague-Dawley rats (n=56) were randomly assigned to one of seven treatment groups. Rats assigned to the control (CON) group were not suspended and received saline injections. All other rats were suspended using the Morey-Holton tail suspension method and were given injections of either saline (SAL) or one of five dosages of GP-2 (.02, .04, .06, .08, .10 ug/kg). Each animal received two intraperitoneal injections per day, given approximately one hour apart, for 12 of the 14 days. Fiber types of the soleus (SOL) and gastrocnemius (GAST) muscles and myosin isoenzyme profiles of the GAST were determined by histochemical techniques and by gel electrophoresis, respectively. **RESULTS.** ANOVA and Tukey's post hoc tests (p<0.05) indicated a significantly lower percent slow twitch fibers (% ST FIB) in the suspended SAL (SUS/SAL) vs SAL/CON. This change was effectively attenuated by all concentrations of GP-2. Although there were no significant group differences in % ST FIB in the GAST, the % of slow myosin 1 (% SM1) in the GAST of the SUS/.10 group did indicate that the .10 ug/kg dose was effective in suppressing the suspension induced decrease in the % SM1 while the other doses were not. Despite some differences in group comparisons between % ST FIB and % SM1 in the GAST, there was a significant correlation between these two measures (r = .63). **CONCLUSION.** Overall, the data indicated that incremental increases in GP-2 resulted in graded dose response increases in % ST FIB and % SM1 and greater attenuation of detrimental skeletal muscle changes produced by conditions which simulated weightlessness in rats.

EFFECTS OF 3 WEEKS CENTRIFUGAL ACCELERATION IN RATS.

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INTRODUCTION. This study was performed to clarify the effects of gravity on physiological parameters in rats exposed to 3 weeks centrifugal accelerations. **METHODS.** The Wistar rats were exposed to either 1G, 1.6G and 3G (n=4 each) continuously for 3weeks. To provide hypergravity, a centrifuge having an arm radius of 1.3m was used. **RESULTS.** During this period, daily changes in body weight, urine volume, food intake, water intake and urinary excretion of catecholamine were measured. In addition, water balance was determined by urine volume and water intake. Body weights in groups 1.6G and 3G decreased by 7% on the 2nd day and by 14% on the 5th day, respectively. They, however, recovered to the pre-exposure control level by the end of the experiment. Food intakes in groups 1.6G and 3G decreased by 68% and 78% on the 1st day, respectively, and recovered to the pre-exposure level on the 12th day. Thereafter, they remained unchanged. Water intakes in groups 1.6G and 3G decreased by 62% and 98% on the 1st day, respectively, and returned to the pre-exposure level on the 3rd day. **CONCLUSION.** It is suggested that body weight and daily intake of food and water decrease in response to acute exposure to hypergravity and that the rate of decrease is influenced by the intensity of gravity.

EFFICIENCY OF CONTINUOUS BLOOD PRESSURE MONITORING DURING LBNP TEST. S.Yumikura*¹⁾, C.Sekiguchi*¹⁾, A.Miyamoto*¹⁾, K.Enomoto*²⁾, R.Maru*²⁾, N.Yamaguchi*²⁾, and K.Yajima*²⁾. 1) NASDA, 2) Nihon University School of Med. Tokyo, Japan

PURPOSE and METHOD: To evaluate the efficiency of continuous blood pressure (BP) monitoring during the LBNP test, the continuous BP monitoring system (Finapres) was used during 30 mmHg LBNP tests. The cases of presyncopal episodes induced by LBNP (n=6) were then analyzed and compared with the intermittent (1-minute interval) hemodynamic impedance cardiography monitoring and 2-minute interval BP monitoring. **RESULTS:** Neither 1-minute interval impedance cardiography (EDVI, HR, SVI, and CI) nor 2-minute interval BP monitoring could indicate the immediate hemodynamic response during the presyncopal episode. However, continuous BP monitoring showed a remarkable decrease of BP and HR during the presyncopal episode. The average duration from the beginning of BP decrease to the LBNP termination was 39.5 sec. Decreases in systolic BP and HR were 43 mmHg, and 27.8 bpm respectively. Since the fall of BP and HR occurred within a minute in most cases, even the 1-minute interval hemodynamic monitoring does not provide sufficient safety during LBNP tests. Continuous (beat-by-beat) BP monitoring is necessary.

EVALUATION OF LYMPHOCYTE POPULATIONS OF NAVY AVIATION PERSONNEL DURING OPERATION DESERT STORM. A. Mateczun*, H.M. Neisler*, L.W. Schoenberg*, N. El Ghorab. Naval Aerospace Medical Research Laboratory, Pensacola, FL 32508-5700 and Naval Medical Research Unit 3, Cairo, Egypt.

INTRODUCTION. The numbers and distributions of lymphocyte populations vary in response to both acute and chronic physical or psychological stress. Deviations from reference ranges may be associated with alterations in blood chemistry, clinical illness, and/or fatigue interfering with job performance or safety. Military personnel have been studied during prolonged operational and training stress to evaluate these changes as potential predictors of stress burnout. This study evaluated deployed aviation personnel during Operation Desert Storm. **METHODS.** Fifty subjects representing aviation, shipboard and medical personnel volunteered for this study. A single blood sample was obtained from each subject for lymphocyte and biochemistry evaluations within 7 days of cessation of combat operations (43 subjects) and after 6 months (7 subjects). Lymphocytes were prepared and fixed immediately, then evaluated within 36 hours. **RESULTS.** Mean values and 95% confidence intervals for the T3, T4, T8 and Natural Killer lymphocytes of these subjects were all within published normal reference ranges. The Helper-Suppressor cell ratios were likewise within normal ranges. The lymphocyte populations were not significantly different among the three subject groups. Confidence intervals for all subjects, and each group separately, were substantially different from published normal reference data. Moreover, values of some individuals within each group fell outside reference ranges. **CONCLUSION.** 1) These subjects did not demonstrate the alterations of lymphocytes indicative of stress and thus were not suffering cumulative immunologic effects of operational stress; 2) The confidence intervals for these subjects are distinctly different from published reference data; and 3) A definitive study to determine the normal reference ranges for aviation personnel is required before conclusions can be drawn about those individuals who fell outside published reference ranges.

EFFECTS OF ATROPINE SULFATE ON HELICOPTER PILOTS. J. A. Caldwell, R. L. Stephens, L. W. Stone, Carter, D. J. U.S. Army Aeromedical Research Laboratory, Fort Rucker, AL 36362-5295.

INTRODUCTION. The threat of chemical warfare with organophosphate poisons has resulted in fielding the antidote atropine sulfate to soldiers. While atropine is the key to survivability once poisoning has occurred, there have been concerns that the drug might be injected after an aviator mistakenly perceives he/she has been exposed to nerve agent. An in-flight investigation was conducted to estimate the operational impact of this scenario. **METHODS.** Twelve Army helicopter pilots were given placebo, 2 mg, and 4 mg atropine and evaluated with vision, cognitive, psychomotor, EEG, and flight tests. **RESULTS.** Effects were seen most often with the 4 mg dose. Flight performance revealed decrements in straight and level, standard-rate turns, a straight climb and descent, steep turns, a climbing turn, an instrument landing system (ILS) approach, and confined area operations. Vision tests showed increases in pupil diameter and double vision with decreases in accommodation. Cognitive tests revealed decrements in logical reasoning, quantitative ability, short-term memory, and choice reaction time. There were also increases in psychomotor tracking errors, and EEGs revealed evidence of decreased activation. **CONCLUSION.** Performance at higher altitudes with up to 4 mg of atropine did not appear to be critically impaired, but performance close to the ground revealed problems. Aviators should avoid flying for a minimum of 12 hours after an injection of atropine.

EFFECTS OF U.S. ARMY NBC INDIVIDUAL PROTECTIVE EQUIPMENT (IPE) ON SIMULATED HELICOPTER FLIGHT. R. Thornton, J. Lynn Caldwell. U.S. Army Aeromedical Research Laboratory, Fort Rucker, AL 36362

INTRODUCTION. Aircrew heat stress due to wearing NBC protective equipment commonly is reported to be a cause of impaired performance in flight. A study was conducted using an environmentally controlled UH-60 helicopter simulator to determine the effects on physiology and performance of wearing the U.S. Army NBC IPE. **METHODS.** Sixteen UH-60 aviators flew the simulator for up to 6 hours in the following conditions: a) flight suit, WBGT 16.8°C; b) flight suit, WBGT 29.4°C; c) NBC IPE, WBGT 16.8°C; d) NBC IPE, WBGT 29.4°C. Rectal and skin temperatures and heart rate were recorded. Flying performance was measured by recording flight parameters twice a second, and calculating RMS deviation from target values. **RESULTS.** Only 9 of the 16 subjects completed the full 6-hour flight profile in the hot NBC condition. All physiological parameters were significantly increased, but there was minimal effect on flight performance. All subjects flew for 6 hours in the other three conditions. **CONCLUSION.** Aircrew operating in NBC IPE in moderately hot conditions suffer significant physiological heat strain. This has little effect on the ability to perform routine helicopter flight.

A COMPARISON OF PULMONARY FUNCTION IN RN0AF PILOTS FLYING FIGHTERS AND MULTI-ENGINE AIRCRAFT C.C. Christensen, I.O. Owe*, O. Schamaun, H.T. Andersen*, I.L. Neslein and L. Lian. RN0AF Institute of Aviation Medicine, PO Box 14, Blindern, 0313 Oslo, NORWAY.

INTRODUCTION: Norwegian military aviators are medically screened at our Institute of Aviation Medicine (IAM) initially on selection, and at 6 year intervals until age forty. Pulmonary function tests routinely performed at IAM and locally, during annual medicals, are: Vital capacity (VC) and forced expiratory volume during the first second of expiration (FEV_{1.0}), with estimation of the ratio of FEV_{1.0} to VC (FEV_{1.0}/VC%). **METHODS:** Based on an observation that fighter pilots seemed to develop a more pronounced reduction in FEV_{1.0}/VC% with age than other aircrew, a statistical analysis was performed. Changes in pulmonary function during the first 6 years in service were compared in pilots flying fighters and multi-engine aircraft. **RESULTS:** There was a significant reduction in FEV_{1.0} in fighter pilots during the first 6 years of observation, while pilots flying multi-engine aircraft did not have a significant FEV_{1.0} reduction over the same period. The VC remained constant in both groups. A significantly higher fraction of the pilots in the fighter group had a reduction in FEV_{1.0}/VC% to values below 70% than in the multi-engine group. **CONCLUSION:** Fighter pilots in the RN0AF develop a significantly greater reduction in FEV_{1.0} during the first 6 years in service than their colleagues flying multi-engine aircraft.

INCONSISTENT CLASSIFICATION AND TREATMENT OF TYPE I/TYPE II DECOMPRESSION SICKNESS. G.B. Kemper*, B.J. Stegmann*, and A.A. Pilmanis. Armstrong Laboratory, Brooks AFB TX 78235, KRUG Life Sciences, San Antonio TX 78235.

INTRODUCTION. In military aviation, decompression sickness (DCS) has historically been symptomatically classified as either Type I or Type II. Type I DCS is generally considered "minor" or synonymous with simple bends; a Type II DCS diagnosis can lead to permanent disqualification of an aircrew member. Despite the potential consequences of a Type II diagnosis, the criteria for differentiating Type I and Type II are unclear and subject to provider bias. We examined individual interpretation in diagnosing and treating patients with suspected DCS. **METHODS.** Experts in both the diving and flying communities were presented with 10 case descriptions of aircrews with specific DCS manifestations and asked to classify them as either Type I or Type II. The experts were also asked to comment on the course of treatment and future flight status in each of the cases. **RESULTS.** Case #1 was the only case diagnosed as Type I by 100% of the experts. All other cases received mixed diagnoses. Cases #5 and #7 were the only cases not considered Type I. However, only 78% felt these cases were of the Type II classification. Six cases were diagnosed as neither Type I nor Type II. All cases diagnosed as Type II were recommended for waiver and return to flying status. **CONCLUSIONS.** The results indicate that significant variations exist in the definition of DCS types, treatment, and flying status disposition. Recommend using clinical descriptions for classifying DCS instead of Type I or Type II.

INCIDENCE OF DECOMPRESSION SICKNESS (DCS) IN HIGH ALTITUDE RECONNAISSANCE PILOTS. A. A. Pilmanis* and R.U. Bisson Armstrong Laboratory, Brooks AFB, TX 78235.

INTRODUCTION. USAF pilots flying U-2/TR-1 reconnaissance aircraft are routinely exposed to cabin altitudes between 28,000 and 30,000 ft for 9 or more hours. One hour of ground level prebreathing with 100% O₂ is used to reduce DCS risk, and 100% O₂ is breathed during flight. Formal reports of DCS are rare (1-2/year). Research subjects exposed to altitude profiles similar to the U-2/TR-1 profiles show a DCS incidence of 73%. **METHODS.** To resolve this incidence discrepancy and document the extent and nature of DCS in the reconnaissance community, an anonymous survey was administered to active U-2/TR-1 pilots. Due to the subjective nature of DCS, and self-diagnosis, there is a high probability for symptom origin other than DCS. Other causes may include immobility, temperature extremes, fatigue, and equipment effects. **RESULTS.** The results showed that the average pilot was 35.5 years old (27 to 46), and had flown 110 high altitude missions (736 high altitude hours). During their career, 62% of the pilots had experienced at least one case of DCS on a high altitude mission. The number of cases per pilot ranged from 1 to 25 (mean of 5.11 cases). There was a 4.2% DCS incidence (#cases/#missions). The predominant symptom was pain (51%). In 31% of the reports, manifestations other than pain were described. These were grouped in 3 categories: skin (14%), neurological (14%), and pulmonary (3%). Specific neurological complaints included: weakness, visual disturbances, and cognitive, speech and equilibrium dysfunction. Only 2 cases resulted in mission abort. The primary reason given (78%) for the reluctance to report DCS was the fear of being grounded. **CONCLUSION.** This survey shows a higher DCS incidence in high altitude reconnaissance pilots than previously reported.

FLYING AFTER DIVING: VALIDATION TESTS FOR MILITARY DIVERS. B.E. Bassett¹, E.D. LaFon¹, and A.A. Pilmanis² HUB, San Antonio TX 78230; ¹USAF School of Aerospace Medicine and ²Armstrong Laboratory, Brooks AFB TX 78235

Introduction: Dives conducted at sea level by military personnel, followed by immediate ascent to altitude present operational requirements beyond the scope of current decompression practices. **Methods:** The limiting tissue nitrogen values (M_D values) were adjusted to 10,000 ft (FAD-I) and 8,500 ft (FAD-II). In FAD-I, military divers were exposed to 6 different dive profiles. After each dive, the subjects ascended to 10,000 ft for 4 hours, followed by 16,000 ft for 1 hour, and then returned to sea level. In FAD-II, the subjects were exposed to 3 different dive profiles followed by altitude exposures as described except that altitudes were reduced to 8,500 and to 14,250 ft respectively. Subjects were monitored for decompression sickness (DCS) and for venous gas emboli (vge) during the altitude exposures. The voluntary, fully informed consent of the subjects used in this research was obtained as required by AFR 169-3. **Results:** FAD-I results (20 different subjects/110 exposures): 10.9% terminated exposures; 4.6% cases of pain-only DCS; 6.4% with vge scores resulting in early termination. FAD-II results (20 different subjects/57 exposures): 5.3% terminated exposures; 1.8% case of pain-only DCS; 3.5% with vge scores resulting in early termination of the exposures. **Conclusions:** Revised surfacing ratio limits (calculated tissue PN_2/PB) were used to calculate no-decompression limits for dives at sea level which allow immediate ascent to altitudes up to 10,000 ft.

ECHOCARDIOGRAPHIC AND COLOUR FLOW FINDINGS IN PILOT CANDIDATES. G.W. Gray^{*} and A.M. Gulino. Defence and Civil Institute of Environmental Medicine, Toronto, Canada, M3M 3B9.

INTRODUCTION: Since 1985, all Canadian Forces pilot candidates have been screened with echocardiography, and since 1989, with colour flow. **METHODS:** From March 1989 through March 1991, 1112 pilot candidates underwent echocardiographic and colour flow screening, with pulsed wave doppler carried out when indicated based on the colour flow. All candidates had undergone medical screening at a Recruiting Center and were presumed to be free of cardiovascular anomalies based on clinical examination and electrocardiography. **RESULTS:** 75/1112 candidates (6.7%) were discovered to have cardiac anomalies disqualifying for pilot training based on echocardiographic findings. 57 (5.1%) had mitral valve prolapse, 12 (1.1%) bicuspid aortic valve, 2 (0.2%) significant aortic regurgitation without bicuspid valve, 2 left ventricular hypertrophy, and 1 atrial septal defect. Other incidental findings included 746/1112 (67%) with tricuspid regurgitation, 719/1112 (65%) with pulmonic regurgitation and 319 (29%) with mitral regurgitation, all of slight to mild degree. Only 19/1112 (1.7%) had slight aortic regurgitation. These incidental findings were not considered disqualifying. **CONCLUSIONS:** Echocardiographic and colour flow screening of candidates for military pilot training detects a significant prevalence of cardiac anomalies missed on routine enrolment screening which if discovered after training could lead to medical grounding. It is considered safe and cost-effective.

CURRENT AND PROPOSED PSYCHIATRIC EXAMINATION STANDARDS FOR AVIATORS. D.R. JONES^{*} AEROPSYCH ASSOCIATES, One Clermont Court, Oakwell Farms, San Antonio, TX 78218-1741

INTRODUCTION: Accurate psychiatric assessment of aviators requires an examination for pertinent signs and symptoms, an acceptable diagnostic nosology, and valid standards for aeromedical recommendations. Little is known about the worldwide variance of these factors. **METHOD:** A questionnaire (mostly in "Yes or No" format) was sent to medical offices of ICAO and IATA constituent agencies. **RESULTS:** We do not know how many agencies received the questionnaires. Of 43 returned, 21 were from government bodies, 20 from private air carriers, and 2 from others. Some answers did not total 43 because of non-responses. Applicants are examined: by aeromedical examiners: yes, 33; no, 6; estimated average time 22 min. Psychiatrists: yes, 13; no, 25; 39 min. Psychologists: yes, 17; no, 17; 71 min. Neurologists: yes, 4; no, 26; 17 min. Psychological tests are given by 24, and EEGs by 9. Fourteen agencies use the American Psychiatric Association's "DSM-III-R," 14 use the WHO's ICD-9. **CONCLUSION:** Psychiatric examination techniques, tests and standards vary worldwide. If standards are not validated against some "gold standard" of performance, they should be based on the collective experience of aeromedical examiners and aviation-oriented psychiatrists and psychologists. We hope to report further on this in the future.

HIV-SEROPOSITIVITY AND FITNESS TO FLY IN AIRCREW OF THE FEDERAL GERMAN ARMED FORCES Dr. P.W. FRANK^{*} ITC GAF MC FS, Dr. U. STOCKER Cpt GAF MC, German Air Force Institute of Aviation Medicine, D-W-8080 Fürstentfeldbruck, Germany

The actual statistic analysis of HIV-screening tests, carried out with military personnel of the Federal German Armed Forces in the period from June 1985 to June 1991, shows a prevalence of 0.21 per 1000 for HIV-infected persons and a prevalence of 0.32 per 1000 for HIV-infected persons including patients with LAS/AIDS. Hitherto, there are 5 known cases of death representing a mortality of 0.0095 per 1000 in the tested period. According to the constitutional law valid in the Federal Republic of Germany and after written consent, aircrew of the German Armed Forces can voluntarily perform the HIV-test during their examination of physical fitness at the GAF IAM. In the period from August 1988 to June 1991 obligatorily testing for HIV-1 antibodies at the time of their physical fitness examination, specially required for training in the USA, showed no proof of HIV-seropositivity. In military aviation, aircrew with HIV-seropositivity are principally classified as "not physically qualified for flying duties" while in Civil Aviation HIV-antibody testing is at present neither laid down respectively recommended. In the opinion of the GAF IAM the introduction of routine and thereby preventive HIV-antibody tests, e.g. at the annual physical evaluation, would be an adequate and legitimate claim particularly with respect to the special flight related and task-associated standards on aircrew.

PERMANENT GROUNDING OF A COMMERCIAL AIRLINE'S PILOTS: A 20-YEAR REVIEW. G. M. Kohn^{*} and R. G. Fennell. United Airlines Medical Department, Chicago, IL 60666.

INTRODUCTION: Preventive medicine has always served as the basic discipline underlying a commercial airline's implementation of flight medicine services. Rates and trends in permanent "grounding" of incumbent aircrew can help determine effectiveness of preventive selection and maintenance practices. A medical records review was conducted to determine the incidence and patterns of pathology in a single airline's experience. **METHODS:** We reviewed the medical records of all pilots who were determined by the Corporate Medical Director to be totally and permanently disabled while on active flight status since 1972. The primary diagnoses were determined and stratified into ten major diagnostic categories. **RESULTS:** Cardiovascular disease was responsible for the largest number of medical groundings, followed by neurological and psychiatric disease, and malignant neoplasms. Trends seem to favor an increasing incidence of psychiatric disease as primary pathology over the past ten years. **CONCLUSION:** New-hire and incumbent physical examinations should stress cardiovascular risk factors, cancer screening, and psychiatric evaluation. An increased amount of interpersonal interaction with the flight surgeon is suggested as an educational and screening intervention.

ASTHMA AND SELECTION OF AVIATORS: ASSESSMENT OF BRONCHIAL REACTIVITY. R. BERTI^{*}, L. URBANI, C. DE ANGELIS, P. MATRICARDI, R. NISINI, G. PETRELLI; Dept. - of Aerospace Medicine and * Health Service of Italian A.F.

INTRODUCTION: Increased airways reactivity (IAR) among pilot candidates has been investigated through routine airways challenge tests (RACT) in order to evaluate the prevalence of IAR, the sensitivity of different methods, and the relationship with atopy. **METHODS:** 100 pilot candidates aged 17-24 y. with negative chest X-ray film, normal pulmonary tests, were administered ultrasonic nebulized distilled water (UNDW) and methacholine challenge test (MCT) in random sequence. A screening test for allergic diseases (Phadiatop) and screening skin tests were also performed. A20%FEV1 fall and/or 100% increase of RAW (measured by shutter method) were considered to be representative of IAR. **RESULTS:** No subject showed IAR after UNDW. After MCT IAR was found in 18 subjects: high in 3 (PD=0-200 of methacholine), moderate in 4 (PD=200-600), low in 11 (PD=600-1200). 14 out of 18 had both FEV1 and RAW simultaneously. Phadiatop and prick tests were positive in 15. **CONCLUSIONS:** The prevalence of IAR, the different sensitivity between methods, the different levels of IAR and the presence of sensitivity to inhalant allergens, found among pilot candidates require discussion and additional work to better define how and to what extent IAR alone relates to flight and in defining the methodology of RACT.

APOPROTEIN B AS A USEFUL TOOL TO FORTELL CARDIO-VASCULAR RISK IN
 NORMAL OR HYPERCHOLESTEROLEMIC SUBJECTS. F. Blanco Rojo, J.M. Pérez *
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INTRODUCTION. It is generally accepted high apo B levels as a reliable predictor of cardio-vascular risk disregarding pathological antecedents. This paper presents the results of a study that measured cholesterol, apo A and apo B plasma levels in otherwise healthy ground and flight workers sample. **METHODS** Total cholesterol was determined by Abbott's enzymatic technic and apo A and B by Behring's Nefelometer immunological method in 398 random workers sample. **RESULTS** 35.40% males and 13.48% females were hypercholesterolemic, being 75% and 68% respectively considered high cardio-vascular risk. 11% males and 4% females with normal cholesterol were also considered high risk, due both to high apo B and low apo A levels. **CONCLUSIONS** Apo B should be determined in Hyper and/or Normocholesterolemic workers when there are other associated factors (smoking, hypertension, diabetes) and/or safety related jobs (aircrews) in order to comply or not harsher therapies to prevent cardio-vascular disease.

REGULATION AND ADAPTATION PROCESSES OF HUMAN BODY IN
 LONG-TERM MICROGRAVITY. A.I. Grigoriev and A.D. Egorov. Institute of
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INTRODUCTION. Mechanisms of regulation and adaptation of cardiovascular, respiratory, muscular-skeletal, hematologic and immune systems in microgravity are discussed in this paper. **METHODS.** Space flight medical investigation results are analyzed and summarized in terms of general physiological mechanisms. **RESULTS.** Microgravity induced elimination of gravity-related deformation and mechanical tension of the human body structures changes afferent input and removes weight-load and hydrostatic blood pressure. As a result, regulation processes are changed and short- and long-term adaptation responses are developed. It was shown, that afferent input changes result in adaptive rearrangement of the functional state of the main human body systems. The fluid shifts are accompanied by reflex changes in regulation of circulation, water-salt metabolism and other systems. The reduction of load upon the human body weight-bearing structures results in partial loss of properties and qualities, acquired by man under influence of the Earth's gravity, and causes changes in the intensity of the oxidative processes, structure-plastic and transport support of a number of body functions. **CONCLUSIONS.** The human body changes, which occur in microgravity result in the involving of the self control and adaptive mechanisms, which in, combination with the countermeasures complex, prevents further progress of disorders and to certain extent smooths them.

INITIAL RESPONSE OF THE CALCIUM HOMEOSTATIC SYSTEM TO SPACEFLIGHT. C.E. Cann*, C.D. Arnaud, B.P. Halloran, M.E. Hammond, D. Matsumoto, S. Sanchez.
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INTRODUCTION Bone loss following spaceflight is well documented, and if left untreated by rational countermeasures could limit manned space exploration. Many consider the loss of bone to occur over long periods, months to years, but the relationship between bone and blood calcium homeostasis allows us to study this problem within the first 48 hours of spaceflight. We hypothesized that the initial response of bone to unloading will be a release of calcium, through increased bone resorption, into the extracellular calcium fluid compartment including blood. If this is correct, the serum parathyroid hormone (PTH) level will decrease in an adaptive response, leading to other observed effects such as increased urinary calcium. We tested this hypothesis in the payload crew of the SLS-1 mission. **METHODS** Serum samples were obtained from four crew (2 male, 2 female) on days L-15, 7, 2, FD2, FD6, R+1 and R+6. We measured serum ionized calcium (Ca⁺⁺), magnesium, phosphorus, intact PTH (IRMA, with measurement of PTH in > 95% of normal subjects) and 1,25 dihydroxyvitamin D using microtechniques developed in our laboratory. **RESULTS** Serum Ca⁺⁺ showed the expected negative correlation with PTH for all samples, confirming biological validity of our data. An unexpected finding was a much stronger correlation for the male crew ($r = -0.8$, $p < 0.001$) than for the female crew ($r = 0.3$, N.S.). Ca⁺⁺ increased markedly (26%) by FD2 and remained elevated (19%) through FD6, with recovery by R+6. PTH decreased by FD2, was low through FD6, and also recovered by R+6. Mg and P did not change. **CONCLUSION** The hypercalcemia is clinically significant, and could be responsible for some symptoms of space adaptation syndrome. The early Ca homeostatic response to spaceflight is consistent with increased bone resorption, but this is not proved. Antiresorptive drugs such as those in research trials in osteoporosis and metastatic bone disease may be useful in preventing bone loss in spaceflight.

MAGNETIC RESONANCE IMAGING (MRI) OF SKELETAL MUSCLES IN
 ASTRONAUTS AFTER 9 DAYS OF SPACE FLIGHT. M. Jaweed¹*, P. Narayana², J. Slovis², I. Butler², V. Schneider¹, A. LeBlanc³, L. Fotedar⁴ and D. Bacon⁵. ¹NASA Johnson Space Center, ²Univ. of Texas Health Science Center, ³Baylor College of Medicine, ⁴KRUG Life Sciences, ⁵Humana Hospital, Houston, TX.

INTRODUCTION: Skylab data indicated that prolonged exposure of human subjects to microgravity environment causes significant muscle atrophy accompanied by reduced muscle strength and fatigue resistance. The objective of this study was to determine decrements in muscle size, if any, in the soleus and gastrocnemius muscles of male and female astronauts after 9 days of space flights. **METHODS:** Eight astronauts, one female and seven male, between the ages of 31 and 59 years, 59-84 Kg in body weight were examined by MRI 2-3 times preflight within 16 days before launch; and 2 days (n=8) and seven days (n=3) after landing. The right leg muscles (gastroc-soleus) were imaged with a lower extremity coil in magnets operating at 1.0 or 1.5 Tesla. The imaging protocol consisted of spin echo with a Tr of 0.70 - 1.5 sec. Thirty to forty 3-5 mm thick slices were acquired in 256 x 128 or 256 x 256 matrices. Acquisition time lasted 20-40 minutes. Multiple slices were measured by computerized planimetry. **RESULTS:** Compared to the preflight, the cross-sectional areas (CSA) of the soleus, gastrocnemius and the leg, at 2 days after landing were reduced (at least $P < 0.05$) 8.9 percent, 13.2 percent and 9.5 percent, respectively. The soleus and the leg of three astronauts evaluated at 7 days postflight, did not show full recovery compared to the preflight values. **CONCLUSIONS:** It is concluded that 9-days of space flight may cause significant decrease in CSA of the leg muscles. The factors responsible for this loss need further delineation.

THE METHODOLOGICAL PRINCIPLES OF MEDICAL CONTROL
 SYSTEMS (MCS) DESIGN FOR LONG DURATION SPACE FLIGHTS
 (LDSF).

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INTRODUCTION. The USSR experience, having been accumulated in LDSF medical support, has shown the necessity of the definite correction and specification of methodology of MCS design. **METHODS.** By use of systemic analysis, the generalized estimation of the results of MC in space has been performed. There have been analyzed the results of examination of 19 Soviet cosmonauts, who performed LDSF, lasting from 2 to 12 months, in 1980-90. Moreover the analogous estimation has been carried out in 556 experiments with volunteers during the modelling of zero-gravity environment. **Results.** The systemic analysis has shown, that in addition to 3 well-known methodological principles (i.e. pathogenesis, "MC by stages" and succession's ones), 4 new principles must be formulated and taken into account. They are the systemic-structural approach, the determinism of the infrastructure of the basic physiologic methods, the notion of the total "image" of MCS, the search of "organ-targets". **CONCLUSION.** The realization of all the above-named methodological principles leads to the significant improvement of the informative and diagnostic possibilities of on-board MCS in LDSF.

RESULTS OF AN INTERNATIONAL SPACE CREW DEBRIEF. P.A. Santy*, A.W. Holland*, L. Looper, and R. Marcondes-North*. UTMB, Galveston, TX 77550; and Johnson Space Center Biobehavioral Laboratory, Houston, TX 77058.

INTRODUCTION. In order to identify potential multicultural and multinational problems for future International Space Station Freedom crew, a crew debrief questionnaire (called an "International Crew Debrief") was developed for U.S. astronauts who flew on Shuttle missions with one or more crewmembers from other countries. **METHODS.** From 1981-90, a total of 20 U.S. astronauts flew on International space missions. Debriefs were mailed to all twenty with instructions not to identify themselves or their specific mission. The debrief focused primarily on preflight training; and postflight incidents of misunderstanding, miscommunication and interpersonal friction among crewmembers. Astronauts were also asked to rate the impact of the incident to the mission (low, medium or high). **RESULTS.** Ten astronauts responded, but only nine responses were able to be scored; for a return rate of 45%. 42 incidents were reported: 9 in the preflight period; 26 inflight; and 7 in the postflight period. Most of these incidents were rated at a low or medium impact, but 5 of the inflight incidents were rated at a "high" mission impact. A number of causes for the problems were listed, and are discussed. **CONCLUSIONS.** The Debrief respondents provide useful and timely recommendations on preflight training which might help facilitate the integration of multinational crews and prevent multicultural or multinational factors from interfering with mission operations.